

**ELEC 2220 Computer Systems**  
**Homework #13**  
**Due: Monday, July 3**

For this assignment, provide answers to the following questions. The required information can be found in the *ARM Cortex-M4 User Guide*, the *STM32F4xx Microcontroller Technical Reference*, and the *STM32F4-Discovery User Manual*. (All available from the course web page.)

1. List the range of memory addresses for the STM32F407 microcontroller's
  - a. Flash memory
  - b. SRAM
  - c. STM microcontroller-specific peripherals
  - d. Cortex-M4 peripherals
2. What is the base address of the block of registers that comprise the Reset and Clock Control (RCC) block?
3. What RCC register contains bits to enable clocks to drive the GPIO ports, and what is the address offset of this register within the RCC block?
4. What are the base addresses of the blocks of registers associated with
  - a. GPIOA
  - b. GPIOB
5. What are the register address offsets within the GPIO blocks for the following GPIO registers:
  - a. GPIOx\_MODER
  - b. GPIOx\_ODR
  - c. GPIOx\_IDR
  - d. GPIOx\_BSRR
6. To which GPIO pins are the four LEDs and the user button connected on the STM32F4-Discovery board?
7. Using the information from questions 2-6, write a sequence of assembly language instructions that would do the following.

*(Create and assemble the program to remove syntax errors, but do not execute it.)*

  - a. Turn on (enable) clocks to drive the two GPIO ports connected to the LEDs and button.
  - b. Configure the GPIO pin connected to the Green LED as an output.
  - c. Write a 1 to the pin to turn on the Green LED by writing to the output data register (ODR) of that GPIO port.
  - d. Write a 0 to the pin to turn off the Green LED by writing to the corresponding bit set/reset register (BSRR).
  - e. Configure the GPIO pin connected to the push button as an input.
  - f. Read the state of the button by reading the input data register (IDR) of that GPIO port.
  - g. Repeat the operation(s) in the last step until the button value is 0.